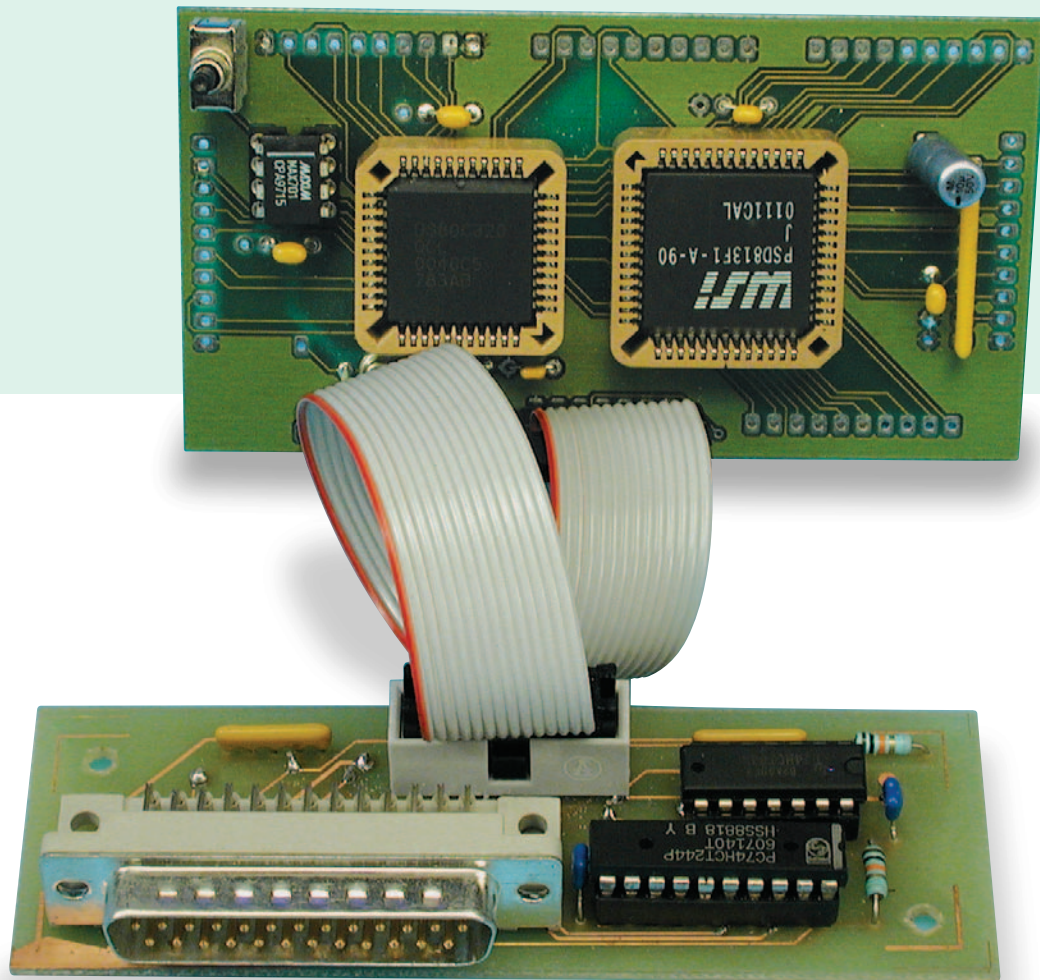


Søren Petersen



Drop-in Microcontroller Board

An 80C32 jack-of-all-trades

At the heart of this remarkably compact microcontroller board you'll find an ingenious bit of integration technology. The combination acts as a versatile plug-in module for lots of applications requiring some form of intelligent control. Thanks to the extensive software that comes with the board and the presence of a PC interface, our drop-in board is excellent for hardware development, too.

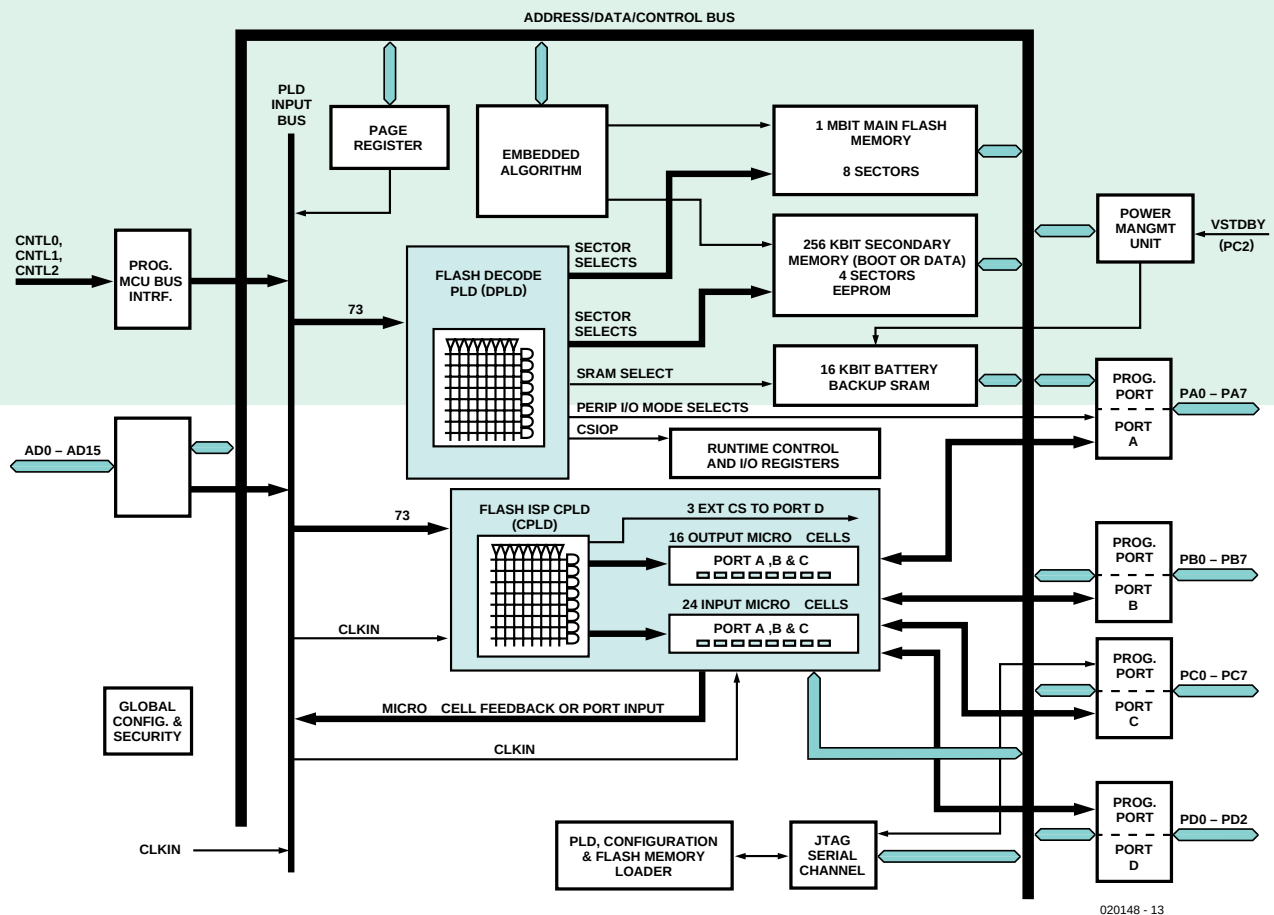


Figure 1. Internal structure of the smart 'all-in-one' chips from the PSD813xxx series.

As many of our readers will be able to confirm, the majority of microcontroller boards look very similar. If the microcontroller used has no program memory, an EPROM is added. Similarly, if there is a lack of RAM, the problem is solved by adding an external RAM device like the 62256. The lot is then complemented with a few logic gates and *hey presto* we have a basic microcontroller system. In some cases the designer will go one step further by employing a little more than just the microcontroller I/O pins. Some more digital electronics is then in order, but that really wraps it up as far as the circuit is concerned.

PSD813 series

Okay, if all these microcontroller circuits are so similar, why not design a single integrated circuit that contains all functionality? That way, circuits can become much smaller and the designer could concentrate on those points that are unique to the circuit. This, we figure, must have gone through the heads of several designers at STMicroelectronics (formerly SGS

Thomson), the general idea having culminated in a series of ICs called 'PSD813xxx'. The individual components inside the chip are found back in **Table 1**. Obviously, this IC offers far more possibilities for a wide variety of microcontroller circuits.

Figure 1 shows a block diagram illustrating the internal structure of the PSD813xxx chips.

The memories may be mapped on a segment by segment basis. This creates many different configurations, for example, first 16 K Flash, followed by two 8 K EEPROM segments and then another 32 K of Flash memory.

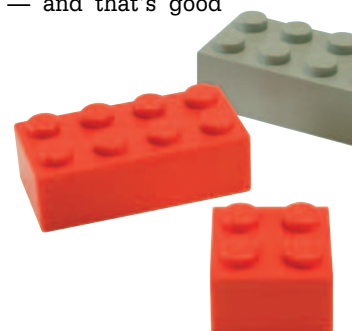
The memory management is also very handy. For example, using the page registers allows you to increase the controller's address range. Another possibility is to configure the memory in a different way depending on the page register contents. The samples show how this is done in practice.

The CPLD section in principle obviates the logic that's normally required to drive peripheral devices, but only if the designer is satisfied with 27 I/O pins. For a controller with a multiplexed bus, this allows a de-multiplexed address

to be created by the chip and, if necessary, a tri-state databus. Other applications include generating chip select signals for the peripheral devices or even creating extra I/O ports.

The PSD813 series has not been designed for one specific family of microcontrollers. In fact, it is so versatile that it can be used with several microcontroller families. These include not only micros with a standard address bus and databus, but also types with a multiplexed data/address bus like the 80C32, 8051XA and the 68HC11.

One final point to mention in this short profile is the JTAG port that allows all functions of the chip to be programmed in-circuit. In other words, it is not necessary to buy an expensive programmer — and that's good news.





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oped that could be 'dropped' into several circuits. The circuit diagram of the drop-in module may be found in **Figure 2**. Even a cursory glance at the drawing should convince you that simplicity is trumps. Thanks to the multifunctional character of the PSD813 chip, this bit of hardware may be used in combination with a microcontroller in many different application circuits. What's more, the JTAG interface makes the total configuration great for

For the heart of the circuit we went for a DS80C320 (IC1). This is an 80C32 compatible micro that's much faster than the ordinary 80C32, hence will not let easily let you down in regard of processing speed. Its main pins are all connected to the PSD813F in position IC2. Furthermore, the circuit contains a microprocessor supervisor circuit built around IC3 and S1, some components to complete the clock oscillator and a handful of small caps to clean and buffer the supply voltage. An on-board power supply is not provided because this module will typically act as an add-on to an existing

A suitable interface to connect the parallel port to the JTAG interface is shown in **Figure 3**. This programmer is directly accessible from the associated program called PSDSoft and that is why we believe it's really indispensable. The programmer is connected to the PC's parallel port via K8 and a cable with 1-to-1 pin correspondence. K9 is the JTAG port — this is con-

Table 1. PSD813 function overview (PSD813F1)

- Memory management
- 8 Flash RAM segments (128 kBytes)
- 4 EEPROM segments (32kBytes)
- SRAM (2 kBytes)
- CPLD (more than 3000 gates)
- 27 configurable I/O ports
- JTAG port
- Programmable power management
- Address and data demultiplexer

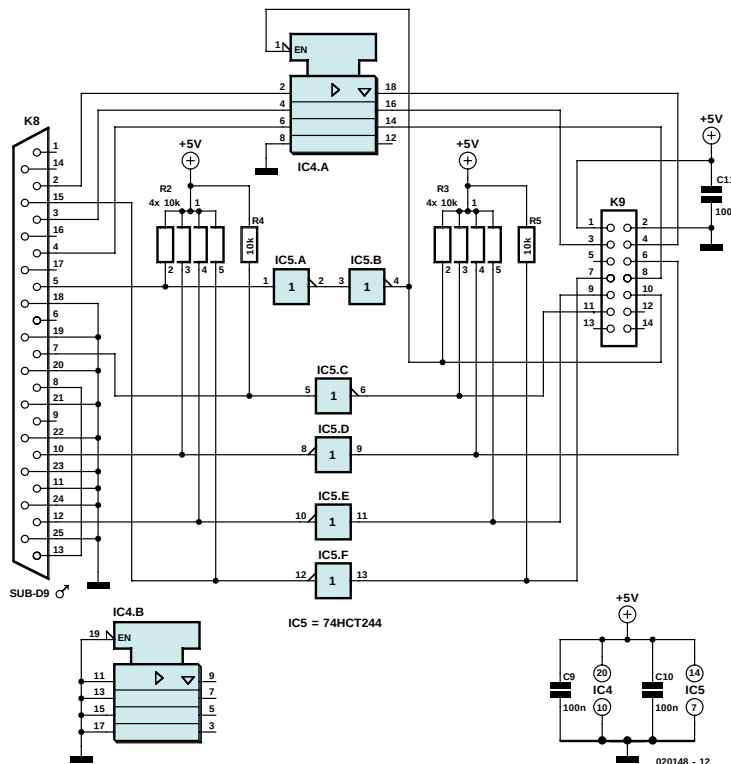


Figure 3. 'Glue' to connect the PC's parallel port to the JTAG interface..

connected to the plug-in module via a 14-way flatcable. IC5 affords buffering and inverting of the signals. The enable input is controlled by the PC, ensuring that the relevant signals do not load the circuit connected when in the 'off' state.

Building it

Having purchased the printed circuit board and all components you are ready to start building the circuit. As shown in **Figure 4**, the PCB consists of two sections that are easily separated using a hacksaw. One section is for the interface with the PC, the other, for the drop-in module proper.

In view of the relatively small number of parts, building up the two sub-boards is unlikely to take much of your time. As usual, we recommend you start with the low-profile parts. For the rest, hardly anything that can go wrong if you stick to the component overlay on the PCB and, of course, the parts list. Connectors K1-K5 have to be soldered at the underside of the board, their task being to link the module to the host equipment in which it is to function. **Figure 5** shows our ready-assembled and tested board.

Before we can test the circuit, we need to look at the software.

Software

The galaxy of features offered by the PSD813F1 may startle instead of encourage. A chip with so many functions is usually difficult to configure and you may quickly feel lost in bits and bytes. Fortunately, STMicroelectronics have written a clearly structured program called PSD-soft Express that may be obtained free of charge from their website at www.st.com. The documentation with the PSD813 series is impressive to say the least.

The program comes with a wizard guiding you through the configuration process in a step-by-step manner, using unambiguous questions. You'll quickly get the hang of the program simply by using it a few times.

To enable everyone to make a head start with the PSD813 chip we produced a small example program that may be downloaded free of charge from our website. The program demonstrates how extra ChipSelect signals and I/O ports may be generated and created respectively.

Having launched PSDSoft Express you are ready to create a new project. Programming the PSD chip could not be easier using the wizard. The individual pins of the PSD chip connected to the JTAG interface and the controller are immediately assigned names by the wizard. **Figure 6** illustrates the ease of defining an extra CS signal. Once all steps have been completed, the PSD chip is ready for programming through the JTAG interface.

Components list

Resistors:

R1 = SIL array 8 x 10k Ω
R2,R3 = SIL array 4 x 10k Ω
R4,R5 = 10k Ω

Capacitors:

C1,C2 = 33pF
C3,C4,C5,C7-C11 = 100nF
C6 = 10 μ F 16V radial

Semiconductors:

IC1 = DS80C320QCL (44-pin PLCC)
IC2 = PSD813F1 (RS Components # 417-5726)
IC3 = MAX701CPA
IC4 = 74HCT244P
IC5 = 74HCT04

Miscellaneous:

K1-K6 = 10-way SIL-header
K7,K9 = 14-way boxheader

K8 = 25-way sub-D plug (male), angled pins, PCB mount
L1 = 1.5 μ H miniature choke
S1 = pushbutton, 1 make contact
X1 = 11.0592MHz quartz crystal
44-way PLCC socket
50-way PLCC socket
PCB, order code **020148-1** (see Readers Services page)
Disk, example project file, order code **020148-11** or **Free Download**

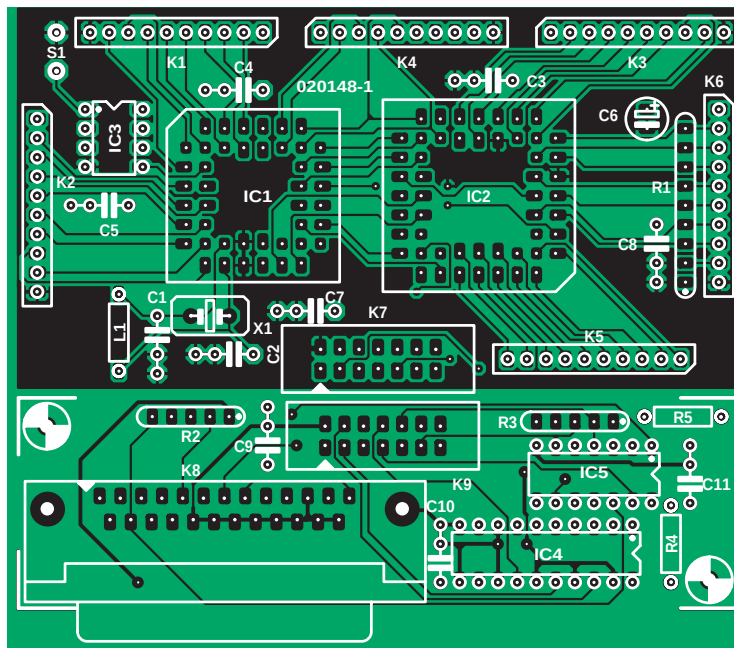


Figure 4. The PCB consists of two sections that are easily separated by sawing.

Finally

The PSD831 chip offers far more possibilities than those used in our simple example. None the less, the drop-in module discussed in this article will not fail to underline the versatility and multifunctional character of the PSD813xxx chips. Together with a suitable microcontroller, these chips form a solid base for a wide range of applications. The PSD813xxx allows much space to be saved in circuits normally requiring an EPROM, Flash memory and a handful of discrete logic.

Thanks to the extensive software support and the ability to be programmed through a JTAG interface, the chip will easily prove worth its salt during circuit development and debugging. Updates to the chip software and hardware (in the CPLD parts) are also easy to implement using the same JTAG interface.

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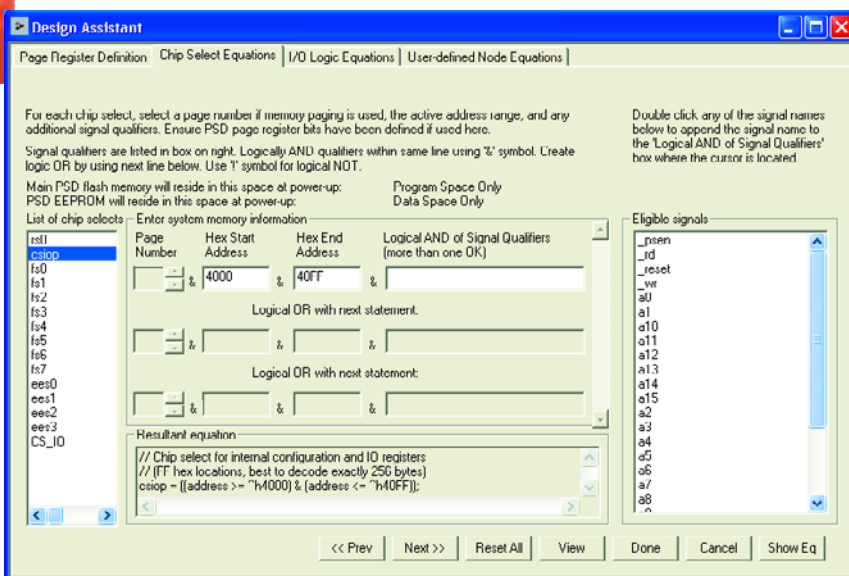


Figure 5. Using ST's PSDsoft Express to assign a software address range.

Free Downloads

– PSD813 example project file.
File number: **020148-11.zip**

– PCB layout in PDF format.
File number: **020148-1.zip**

www.elektor-electronics.co.uk/dl/dl.htm,

select month of publication.